MSCA COFUND Doctoral Fellowships "AMP and ADP Heterogeneity in Cellular Microdomains"

Summary

This PhD topic is part of the INNOCHEMBIO Doctoral Programme, which is funded through the Marie Skłodowska-Curie Actions (MSCA) COFUND action. The main objective of INNOCHEMBIO is to train future experts of sustainable chemistry and biotechnology, helping Europe to take the next steps in the green transition. This project aims to develop and apply cutting-edge methodologies to detect and quantify the spatial heterogeneity of AMP and ADP within cardiomyocyte microdomains. Additionally, to develop mathematical models to analyze the experimental data and predict how microdomain formation influences AMPK signaling cascades and mitochondrial respiratory regulation. This PhD position will be hosted at TalTech with main supervisor Prof. Marko Vendelin and will contain a secondment to co-supervisor Prof. Uwe Schlattner at Université Grenoble Alpes (FR).

Research field:	Chemistry and biotechnology
Supervisor:	Prof. Dr. Marko Vendelin
Availability:	This position is available.
Offered by:	School of Science
	Department of Cybernetics
Application deadline:	Applications are accepted between July 01, 2025 00:00 and August 31, 2025 23:59 (Europe/Zurich)

Description

1. General description of programme and host

The PhD fellowship is part of the Marie Skłodowska-Curie Actions (MSCA) COFUND doctoral programme IN-NOCHEMBIO (https://taltech.ee/en/innochembio), which is co-funded by the European Union (Grant agreement 101217295). The main objective of INNOCHEMBIO is to train future experts to help Europe take the next steps in the green transition. The solutions and trained experts can reduce the environmental impact of the chemical and agricultural industries, offer eco-friendly analytical techniques, and assess the safety of new materials. INNOCHEM-BIO funding will co-finance **15 PhD positions**, for which the application process in the first call will start on the **1st of July in 2025**.

For 12 PhD positions the hosting institution will be Department of Chemistry and Biotechnology (DCB) at Tallinn University of Technology (TalTech) which combines three divisions – Chemistry, Gene Technology and Biomedicine, and Food and Biotechnology. DCB is developing solutions to the great challenges of the 21st century – climate change, environmental protection, carbon neutrality, renewable energy, and biodiversity conservation. DCB hosts the second biggest PhD programme in TalTech with nearly a hundred enrolled students.

For 3 PhD positions the hosting institution will be the implementing partner – National Institute of Chemical Physics and Biophysics (NICPB). NICPB is a public research institution that conducts both fundamental and applied research, developing novel directions in fields ranging from material sciences to informatics. NICPB houses the Laboratory of Environmental Toxicology and several laboratories focused on fundamental research in NMR technologies with expertise dating back decades. The PhD training activities conducted by NICPB are funded through TalTech.

Importantly, each PhD project has one co-supervisor from another European country, which is detailed under the specific offer (see under supervisors' section). In total, INNOCHEMBIO has **19 associate partners from 11 European countries**.

2. Description of specific PhD project

The intracellular environment of cardiomyocytes is remarkably complex, characterized by densely packed membrane structures, organelles, and protein assemblies. This architectural complexity creates distinct microdomains within the cell that may exhibit significant heterogeneity in the distribution of critical metabolic nucleotides, particularly AMP and ADP. Such spatial heterogeneity is not merely a structural curiosity but potentially a crucial determinant of localized metabolic regulation through sensors like AMP-activated protein kinase (AMPK), a major regulator of cellular energy homeostasis.

The primary objective of this research is to develop and apply cutting-edge methodologies to detect and quantify the spatial heterogeneity of AMP and ADP within cardiomyocyte microdomains. To achieve this goal, we will employ AMPfret, a novel fluorescent biosensor specifically designed to monitor adenine nucleotide ratios in living cells.

We aim to:

1. Optimize the signal-to-noise ratio of the AMPfret sensor by integrating advanced biophysical techniques, such as Förster resonance energy transfer (FRET) with scanning fluorescence cross-correlation spectroscopy.

2. Measure local ATP/AMP and ATP/ADP ratios under various physiological and pathophysiological conditions to map the metabolic landscape within cardiomyocytes.

3. Develop mathematical models to analyze the experimental data and predict how microdomain formation influences AMPK signaling cascades and mitochondrial respiratory regulation.

This project offers PhD candidates the opportunity to work at the exciting intersection of multiple disciplines, including cellular and molecular biology, advanced microscopy, biophysics, and systems biology. Depending on their interests and background, candidates can focus on optimizing experimental approaches and measurements or developing mathematical models for data analysis and prediction.

The successful candidate will gain expertise in designing and conducting complex cellular experiments, mastering state-of-the-art imaging techniques, applying molecular biology methodologies, and developing quantitative analytical frameworks. This comprehensive skill set will prepare them for a successful career in biomedical research, where interdisciplinary approaches are increasingly essential for addressing complex biological questions.

By uncovering the spatial dynamics of metabolic regulation in cardiomyocytes, this research has significant implications for understanding cardiac physiology and potentially identifying novel therapeutic targets for heart disease, one of the leading causes of mortality worldwide.

Link to the project: https://taltech.ee/en/innochembio/vendelin

3. Supervisory team

- Tallinn University of Technology (main supervisor): Prof. Marko Vendelin
- Université Grenoble Alpes (France): Prof. Uwe Schlattner (The PhD student will stay 6-16 months at the co-supervisor's lab as mutually agreed upon).
- Tallinn University of Technology: Dr. Rikke Birkedal Nielsen

4. Requirements

- Excellent command of written and spoken English.
- MSc degree or equivalent in relevant field.
- Compliance with the rules of INNOCHEMBIO (e.g. eligibility, adhering to MSCA mobility rules, etc.).
- The primary workplace will be in Estonia. Therefore, candidates from outside the EU must be eligible to obtain a visa. The position is expected to start in the first half of 2026.
- The candidate should hold a master's degree (or equivalent) in chemistry, materials science, or a related field.
- A clear interest in the topic of the position.
- Capacity to work both as an independent researcher and as part of an international team.
- Capacity and willingness to provide assistance in organizational tasks relevant to the project.

For experimental work:

- Experience with laboratory work and cell culture.

For modeling work:

- Programming in Python or C++.
- Experience with development of mathematical models.
- Experience with solving numerically ODEs and/or PDEs.

The following experience is beneficial:

- Experience with microscopy and imaging.
- Experience with heart or skeletal muscle physiology.
- Working knowledge of SQL.

- Working knowledge of statistics and statistical software.

5. Duties and Responsibilities

- Undertake postgraduate research for specific doctoral research project at TalTech or NICPB, respectively.
- Present and publish research in both academic and non-academic audiences. Attend and participate in academic and non-academic conferences, events and seminars.
- Attend and participate in all training events and supervisory meetings.
- Be seconded to the associated partner as necessary to fulfil the grant obligations.
- Prepare progress reports and similar documents on research for funding bodies, as required.
- Actively contribute to the public engagement and outreach activities of the project.
- The above job descriptions are not exhaustive, the PhD candidate may be required to undertake other tasks, which are broadly in line with the above duties and responsibilities.
- Full-time employment (40 hours per week), temporary contract for 4 years.

6. Eligibility requirements

- The applicant must be a doctoral candidate (i.e. not already in possession of a doctoral degree at the date of the recruitment).
- At the time of recruitment, the researcher must not have resided or carried out their main activity (work, studies, etc.) in Estonia for more than 12 months in the three years immediately prior to the recruitment date. Compulsory national service and/or short stays such as holidays are not taken into account.

7. Benefits

- Competitive funding scheme, with a minimum gross monthly salary of EUR 2500. Topped by additional mobility allowances as well as optional family allowances (if applicable).
- Covered tuition costs, research costs and funding for short term mobility (i.e. conference attendance).
- Interdisciplinary and international research projects.
- Early-stage researcher position, with corresponding social and medical benefits in Estonia.
- Becoming a Marie Skłodowska-Curie PhD fellow.

8. How to Apply

All applications must be sent through TalTech's official application platform Glowbase and only applications submitted here will be considered for the programme. We ask the candidates not to contact the supervisors directly, in case of questions please write at innochembio@taltech.ee. Each application must include the following material: CV, 1-page motivation letter, copies of BSc and MSc study records and diplomas, scanned copy of valid photo ID, 2 reference letters, eligibility statement.

NB! The INNOCHEMBIO programme has additional requirements compared to the standard TalTech application process. Details on the exact nature of these documents and how to insert them in Glowbase can be found at our official INNOCHEMBIO website: https://taltech.ee/en/innochembio/application-process. **If any of the required documents are missing, the candidate will not be eligible to proceed to the selection stage.**

9. Selection Process

The selection and recruitment process will be in accordance with the European Charter and Code of Conduct for the Recruitment of Researchers. The recruitment process will be open, transparent, impartial, equitable, and merit-based. There will be no overt/covert discrimination based on race, gender, sexual orientation, religion or belief, disability or age. To this end, the following selection criteria will be considered.

The application deadline is 31 August 2025. The application process will be carried out in 3 steps. In short, first an eligibility check is performed. All eligible candidates will proceed to stage 1, where they will be evaluated by independent evaluators based on the application documents. Lastly, shortlisted candidates from stage 1 will proceed to stage 2, where they will be interviewed via teleconference, which will be used to determine a candidate to whom an offer will be made. All candidates will be informed about the progress in due course after each step of the process. The selection process is described on the guide for applicants available here: https://taltech.ee/en/innochembio/application-process.

10. Disclaimer

By applying for this position, the applicants

1. give their consent to circulate their application and personal data within the INNOCHEMBIO consortium and with the evaluators;
2. confirm that the data provided is valid and accurate;
3. confirm compliance with the eligibility requirements;
4. commit to undertaking the planned secondment at the co-supervisor's institution.

To get more information or to apply online, visit https://taltech.glowbase.com/positions/1020 or scan the the code on the left with your smartphone.